

### REMARKS

The Office action mailed October 6, 2005, has been received and its contents carefully noted. The pending claims, claims 19-22, were rejected. Therefore, reconsideration in view of the following remarks is respectfully requested.

#### Rejection under 35 U.S.C. 103(a)

The Examiner maintained the rejection of claims 19-22 under 35 U.S.C. 103(a) as being unpatentable over Niino et al. in view of JP 07-335563 and as evidenced by Sandhu et al. (US 6,201,219) and CAS No. 7790-91-2 (CAS) or Matsuda et al. (US 5,413,967).

Specifically, the Examiner deemed that Sandhu et al. teaches that  $\text{NF}_3$  and  $\text{ClF}_3$  are equivalent for use as a cleaning gas for thermal chamber cleaning. The Examiner also deemed that JP 07-335563 discloses activating the  $\text{NF}_3$  cleaning gas by its decomposition before the introduction into the reaction container. The Examiner noted that Niino et al. is silent about the preheating temperature ranging from 300°C to 1000°C, but indicated that the thermal decomposition temperature of  $\text{ClF}_3$  is above 220°C as evidenced by CAS. Thus, the Examiner deemed that although JP 07-335563 and Niino et al. do not expressly state that the cleaning gas is heated in the range of 300°C to 1000°C, the decomposition temperature (*above* 220°C, i.e., 380°C as taught by Matsuda et al.) is an intrinsic property which is inherently present in the combined teachings of the prior art.

Applicants respectfully submit that one of ordinary skill in the art would not have been motivated to combine the teachings of Niino et al. with those of JP 07-335563, Sandhu et al. CAS, or Matsuda et al., with a *reasonable* likelihood of *success*. Sandhu et al. generally states that various gases, including  $\text{NF}_3$  and  $\text{ClF}_3$ , may be used for cleaning, but the particular gas used depends upon the material to be removed. However, Sandhu et al. does not teach or provide any suggestion that  $\text{NF}_3$  and  $\text{ClF}_3$  exhibit equivalent properties such that they may be employed in the same processes and apparatuses. In particular, Sandhu et al. does not teach or suggest that at decomposition temperatures,  $\text{NF}_3$  and  $\text{ClF}_3$  and their decomposition products will be substantially equivalent and exhibit substantially similar properties such that  $\text{NF}_3$  and  $\text{ClF}_3$  may be used interchangeably in the same cleaning processes and apparatuses. Thus, nowhere does Sandhu et al. teach or suggest that the decomposition products of  $\text{NF}_3$  and  $\text{ClF}_3$  may be used

interchangeably in the same process at 300 to 1000 °C, or even at their respective decomposition temperatures.

Sandhu et al. attempts to solve the problem of removing uneven deposits of material by patterning heat elements to heat the areas having greater deposits of material. Nowhere does Sandhu et al. teach or suggest that the properties of various cleaning gases are equivalent at any given temperature. Thus, Sandhu et al. suggests, at most, that  $\text{NF}_3$  and  $\text{ClF}_3$  may be used as cleaning gases in accordance with the invention of Sandhu et al., wherein the surfaces of areas to be cleaned are heated. Sandhu et al. does not teach or suggest that  $\text{NF}_3$  and  $\text{ClF}_3$  and their decomposition products are equivalent for use in processes where the cleaning gases are heated to decomposition temperatures.

$\text{NF}_3$  and  $\text{ClF}_3$  have different chemical and physical properties which make them distinctly different gases. Different compounds may exhibit similar properties under certain conditions. Thus, simply pointing to Sandhu et al. as indicating that  $\text{NF}_3$  and  $\text{ClF}_3$  are equivalent under the conditions as contemplated in the process of Sandhu et al. does not create a reasonable likelihood of success in those of ordinary skill in the art that  $\text{NF}_3$  and  $\text{ClF}_3$  are equivalent under different conditions, i.e. decomposition temperatures, in different processes, i.e. according to Niino et al. Much more than simply pointing to the known decomposition temperatures of each gas is needed to reasonably extrapolate that  $\text{NF}_3$  and  $\text{ClF}_3$  would likely exhibit similar properties upon decomposition, when applied in the process of Niino et al.

On the other hand, the Material Safety Data Sheet for  $\text{NF}_3$  (attached herewith) indicates that  $\text{NF}_3$  has a NFPA health rating of 1.  $\text{NF}_3$  NFPA ratings for fire and reactivity are 0. Decomposition of  $\text{NF}_3$  provides  $\text{N}_2$  and HF gas. The Material Safety Data Sheet for  $\text{ClF}_3$  (attached herewith), by contrast, indicates that  $\text{ClF}_3$  has a NFPA health rating of 4 and a reactivity rating of 3. Inhalation of  $\text{ClF}_3$  may cause death.  $\text{ClF}_3$  may spontaneously explode upon exposure to incompatible materials and containers of  $\text{ClF}_3$  may explode if exposed to heat. Further, decomposition of  $\text{ClF}_3$  produces toxic chlorine gas.

Assuming *arguendo* that  $\text{NF}_3$  and  $\text{ClF}_3$  are equivalent for use as a cleaning gas at the same temperatures and in the same processes and in the same apparatuses, one ordinarily skilled in the art would not risk the hazards of  $\text{ClF}_3$  if  $\text{NF}_3$  is just as good. One skilled in the art would not have been motivated to risk the hazards of using  $\text{ClF}_3$ , especially at its decomposition

temperatures. Nowhere does the cited prior art teach or suggest that the benefits of employing  $\text{ClF}_3$  gas at its decomposition temperatures outweighs the risks of being (1) highly explosive upon exposure to incompatible materials and high temperatures, (2) deathly toxic, and (3) decomposing into toxic chlorine gas.

None of the cited prior art teach or suggest that  $\text{ClF}_3$  and  $\text{NF}_3$  exhibit equivalent properties at their decomposition temperatures such that they may be used interchangeably in the same processes and apparatuses. None of the cited prior art teach or suggest that the benefits of employing  $\text{ClF}_3$  gas at its decomposition temperatures outweighs its risks such that one would have been motivated to employ  $\text{ClF}_3$  rather than  $\text{NF}_3$ . Thus, one of ordinary skill in the art would not have been motivated to preheat  $\text{ClF}_3$  to its decomposition temperature in the process according to the present invention.

Since the requisite motivation for employing  $\text{ClF}_3$  at decomposition temperatures is lacking, a prima facie case of obviousness has not been established. Therefore, the rejection under 35 U.S.C. 103(a) should properly be withdrawn.

**Request for Interview**

Applicants respectfully request either a telephonic or an in-person interview should there be any remaining issues.

### CONCLUSION

All of the stated grounds of objection and rejection have been properly traversed, accommodated, or rendered moot. Applicants therefore respectfully request that the Examiner reconsider all presently outstanding objections and rejections and that they be withdrawn. It is believed that a full and complete response has been made to the outstanding Office Action and, as such, the present application is in condition for allowance. If the Examiner believes, for any reason, that personal communication will expedite prosecution of this application, the Examiner is invited to telephone the undersigned at the number provided.

It is not believed that extensions of time are required, beyond those that may otherwise be provided for in accompanying documents. However, in the event that additional extensions of time are necessary to prevent abandonment of this application, then such extensions of time are hereby petitioned under 37 C.F.R. §1.136(a), and any fees required therefor are hereby authorized to be charged to **Deposit Account No. 02-4300**, Attorney Docket No. **033082M0871**.

Respectfully submitted,

SMITH, GAMBRELL & RUSSELL, LLP



Michael A. Makuch  
Reg. No. 32,263

Date: December 15, 2005

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## MATERIAL SAFETY DATA SHEET

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### 1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

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**MATHESON TRI-GAS, INC.**  
**959 ROUTE 46 EAST**  
**PARSIPPANY, NEW JERSEY 07054-0624**

**EMERGENCY CONTACT:**  
**CHEMTREC 1-800-424-9300**  
**INFORMATION CONTACT:**  
**973-257-1100**

### SUBSTANCE: NITROGEN TRIFLUORIDE

#### TRADE NAMES/SYNONYMS:

MTG MSDS 146; NITROGEN FLUORIDE (NF3); PERFLUOROAMMONIA; TRIFLUOROAMINE;  
TRIFLUOROAMMONIA; TRIFLUORAMINE; TRIFLUORAMMONIA; UN 2451; F3N; MAT16650;  
RTECS QX1925000

**CHEMICAL FAMILY:** halogens

**CREATION DATE:** Jan 24 1989

**REVISION DATE:** Dec 15 2003

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### 2. COMPOSITION, INFORMATION ON INGREDIENTS

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**COMPONENT:** NITROGEN TRIFLUORIDE  
**CAS NUMBER:** 7783-54-2  
**PERCENTAGE:** 100.0

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### 3. HAZARDS IDENTIFICATION

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**NFPA RATINGS (SCALE 0-4):** HEALTH=1 FIRE=0 REACTIVITY=0

#### EMERGENCY OVERVIEW:

**COLOR:** colorless

**PHYSICAL FORM:** gas

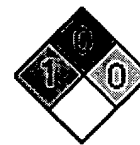
**ODOR:** damp, moldy odor

**MAJOR HEALTH HAZARDS:** blood damage

**PHYSICAL HAZARDS:** Containers may rupture or explode if exposed to heat. Strong oxidizer. Contact with combustible material may cause fire.

#### POTENTIAL HEALTH EFFECTS:

**INHALATION:**





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**SHORT TERM EXPOSURE:** same as effects reported in short term ingestion, irritation (possibly severe), nausea, vomiting, difficulty breathing, asthma, irregular heartbeat, headache, drowsiness, dizziness, bluish skin color, lung congestion, convulsions, coma

**LONG TERM EXPOSURE:** same as effects reported in short term exposure

**SKIN CONTACT:**

**SHORT TERM EXPOSURE:** same as effects reported in short term ingestion, irritation (possibly severe)

**LONG TERM EXPOSURE:** same as effects reported in short term exposure

**EYE CONTACT:**

**SHORT TERM EXPOSURE:** irritation (possibly severe)

**LONG TERM EXPOSURE:** same as effects reported in short term exposure

**INGESTION:**

**SHORT TERM EXPOSURE:** burns, rash, nausea, diarrhea, stomach pain, difficulty breathing, irregular heartbeat, headache, tingling sensation, visual disturbances, dilated pupils, bluish skin color, paralysis, convulsions, coma

**LONG TERM EXPOSURE:** no information on significant adverse effects

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#### 4. FIRST AID MEASURES

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**INHALATION:** If adverse effects occur, remove to uncontaminated area. Give artificial respiration if not breathing. If breathing is difficult, oxygen should be administered by qualified personnel. Get immediate medical attention.

**SKIN CONTACT:** Wash skin with soap and water for at least 15 minutes while removing contaminated clothing and shoes. Get immediate medical attention. Thoroughly clean and dry contaminated clothing and shoes before reuse. Destroy contaminated shoes.

**EYE CONTACT:** Immediately flush eyes with plenty of water for at least 15 minutes. Then get immediate medical attention.

**INGESTION:** If a large amount is swallowed, get medical attention.

**ANTIDOTE:** methylene blue, intravenous; ascorbic acid, intravenous.

**NOTE TO PHYSICIAN:** For inhalation, consider oxygen.

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#### 5. FIRE FIGHTING MEASURES

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**FIRE AND EXPLOSION HAZARDS:** Negligible fire hazard. Oxidizer. May ignite or explode on contact with combustible materials.

**EXTINGUISHING MEDIA:** carbon dioxide, regular dry chemical

Large fires: Use regular foam or flood with fine water spray.



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**FIRE FIGHTING:** Do not get water inside container. Move container from fire area if it can be done without risk. Cool containers with water spray until well after the fire is out. Stay away from the ends of tanks. Keep unnecessary people away, isolate hazard area and deny entry. Use extinguishing agents appropriate for surrounding fire. Flood with fine water spray. Cool containers with water spray until well after the fire is out. Apply water from a protected location or from a safe distance. Avoid inhalation of material or combustion by-products. Stay upwind and keep out of low areas. Consider downwind evacuation if material is leaking.

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## 6. ACCIDENTAL RELEASE MEASURES

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### **OCCUPATIONAL RELEASE:**

Stop leak if possible without personal risk. Reduce vapors with water spray. Do not get water directly on material. Do not get water inside container. Keep unnecessary people away, isolate hazard area and deny entry. Small spills: Flood with water. Large spills: Dike for later disposal. Stay upwind and keep out of low areas. Ventilate closed spaces before entering. Evacuation radius: 150 feet.

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## 7. HANDLING AND STORAGE

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**STORAGE:** Store and handle in accordance with all current regulations and standards. Keep separated from incompatible substances.

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## 8. EXPOSURE CONTROLS, PERSONAL PROTECTION

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### **EXPOSURE LIMITS:**

#### **NITROGEN TRIFLUORIDE:**

10 ppm (29 mg/m<sup>3</sup>) OSHA TWA

10 ppm ACGIH TWA

10 ppm (29 mg/m<sup>3</sup>) NIOSH recommended TWA 10 hour(s)

**VENTILATION:** Provide local exhaust ventilation system. Ensure compliance with applicable exposure limits.

**EYE PROTECTION:** Wear splash resistant safety goggles with a faceshield. Provide an emergency eye wash fountain and quick drench shower in the immediate work area.

**CLOTHING:** Wear appropriate chemical resistant clothing.

**GLOVES:** Wear appropriate chemical resistant gloves.

**RESPIRATOR:** The following respirators and maximum use concentrations are drawn from NIOSH and/or OSHA.

**100 ppm**

Any chemical cartridge respirator with cartridge(s) providing protection against this substance.

Any supplied-air respirator.



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**250 ppm**

Any supplied-air respirator operated in a continuous-flow mode.

Any powered, air-purifying respirator with cartridge(s) providing protection against this substance.

**500 ppm**

Any chemical cartridge respirator with a full facepiece and cartridge(s) providing protection against this substance.

Any air-purifying respirator with a full facepiece and a canister providing protection against this substance.

Any powered, air-purifying respirator with a tight-fitting facepiece and cartridge(s) providing protection against this substance.

Any supplied-air respirator with a tight-fitting facepiece that is operated in a continuous-flow mode.

Any self-contained breathing apparatus with a full facepiece.

Any supplied-air respirator with a full facepiece.

**1000 ppm**

Any supplied-air respirator with a full facepiece that is operated in a pressure-demand or other positive-pressure mode.

**Escape -**

Any air-purifying respirator with a full facepiece and a canister providing protection against this substance.

Any appropriate escape-type, self-contained breathing apparatus.

**For Unknown Concentrations or Immediately Dangerous to Life or Health -**

Any supplied-air respirator with full facepiece and operated in a pressure-demand or other positive-pressure mode in combination with a separate escape supply.

Any self-contained breathing apparatus with a full facepiece.

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## 9. PHYSICAL AND CHEMICAL PROPERTIES

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**PHYSICAL STATE:** gas

**COLOR:** colorless

**ODOR:** damp, moldy odor

**MOLECULAR WEIGHT:** 71.00

**MOLECULAR FORMULA:** F3-N

**BOILING POINT:** -200 to -184 F (-129 to -120 C)

**FREEZING POINT:** -359 to -341 F (-217 to -207 C)

**VAPOR PRESSURE:** 1500 mmHg @ -119 C

**VAPOR DENSITY (air=1):** 2.46

**SPECIFIC GRAVITY:** Not applicable

**DENSITY:** 2.96 g/L @ 20 C

**WATER SOLUBILITY:** slightly soluble

**PH:** Not applicable

**VOLATILITY:** Not applicable

**ODOR THRESHOLD:** Not available

**EVAPORATION RATE:** Not applicable

**VISCOSITY:** 0.018 cP @ 25 C

**COEFFICIENT OF WATER/OIL DISTRIBUTION:** Not applicable





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## 10. STABILITY AND REACTIVITY

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**REACTIVITY:** Stable at normal temperatures and pressure.

**CONDITIONS TO AVOID:** Minimize contact with material. Avoid inhalation of material or combustion by-products. Containers may rupture or explode if exposed to heat.

**INCOMPATIBILITIES:** combustible materials, bases, reducing agents, metals

**HAZARDOUS DECOMPOSITION:**

Thermal decomposition products: halogenated compounds

**POLYMERIZATION:** Will not polymerize.

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## 11. TOXICOLOGICAL INFORMATION

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**NITROGEN TRIFLUORIDE:**

**TOXICITY DATA:**

6700 ppm/1 hour(s) inhalation-rat LC50

**ACUTE TOXICITY LEVEL:**

Moderately Toxic: inhalation

**TARGET ORGANS:** blood

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## 12. ECOLOGICAL INFORMATION

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Not available

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## 13. DISPOSAL CONSIDERATIONS

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Dispose in accordance with all applicable regulations. Subject to disposal regulations: U.S. EPA 40 CFR 262. Hazardous Waste Number(s): D001.

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## 14. TRANSPORT INFORMATION

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**U.S. DOT 49 CFR 172.101:**

**PROPER SHIPPING NAME:** Nitrogen trifluoride

**ID NUMBER:** UN2451

**HAZARD CLASS OR DIVISION:** 2.2

**LABELING REQUIREMENTS:** 2.2; 5.1





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**CANADIAN TRANSPORTATION OF DANGEROUS GOODS:**

**SHIPPING NAME:** Nitrogen trifluoride, compressed

**UN NUMBER:** UN2451

**CLASS:** 2.2; 5.1

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**15. REGULATORY INFORMATION**

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**U.S. REGULATIONS:**

**CERCLA SECTIONS 102a/103 HAZARDOUS SUBSTANCES (40 CFR 302.4):** Not regulated.

**SARA TITLE III SECTION 302 EXTREMELY HAZARDOUS SUBSTANCES (40 CFR 355.30):** Not regulated.

**SARA TITLE III SECTION 304 EXTREMELY HAZARDOUS SUBSTANCES (40 CFR 355.40):** Not regulated.

**SARA TITLE III SARA SECTIONS 311/312 HAZARDOUS CATEGORIES (40 CFR 370.21):**

ACUTE: Yes

CHRONIC: No

FIRE: No

REACTIVE: No

SUDDEN RELEASE: Yes

**SARA TITLE III SECTION 313 (40 CFR 372.65):** Not regulated.

**OSHA PROCESS SAFETY (29CFR1910.119):**

**NITROGEN TRIFLUORIDE:** 5000 LBS TQ

**STATE REGULATIONS:**

**California Proposition 65:** Not regulated.

**CANADIAN REGULATIONS:**

**WHMIS CLASSIFICATION:** Not determined.

**NATIONAL INVENTORY STATUS:**

**U.S. INVENTORY (TSCA):** Listed on inventory.

**TSCA 12(b) EXPORT NOTIFICATION:** Not listed.

**CANADA INVENTORY (DSL/NDSL):** Not determined.

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**16. OTHER INFORMATION**

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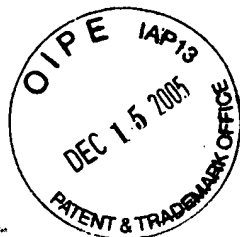
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## MATERIAL SAFETY DATA SHEET

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### 1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

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**MATHESON TRI-GAS, INC.**  
**959 ROUTE 46 EAST**  
**PARSIPPANY, NEW JERSEY 07054-0624**

**EMERGENCY CONTACT:**  
**CHEMTREC 1-800-424-9300**  
**INFORMATION CONTACT:**  
**973-257-1100**

**SUBSTANCE: CHLORINE TRIFLUORIDE**

**TRADE NAMES/SYNONYMS:**

MTG MSDS 202; CHLORINE FLUORIDE; CHLOROTRIFLUORIDE; CTF; UN 1749; STCC 4918210; MAT04650; RTECS FO2800000

**CHEMICAL FAMILY:** halogens

**CREATION DATE:** Jan 24 1989

**REVISION DATE:** Mar 19 2003

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### 2. COMPOSITION, INFORMATION ON INGREDIENTS

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**COMPONENT:** CHLORINE TRIFLUORIDE

**CAS NUMBER:** 7790-91-2

**PERCENTAGE:** 100.0

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### 3. HAZARDS IDENTIFICATION

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**NFPA RATINGS (SCALE 0-4):** HEALTH=4 FIRE=0 REACTIVITY=3

**EMERGENCY OVERVIEW:**

**COLOR:** colorless

**PHYSICAL FORM:** gas

**ODOR:** sweet odor, pungent odor

**MAJOR HEALTH HAZARDS:** potentially fatal if inhaled, respiratory tract burns, skin burns, eye burns, mucous membrane burns

**PHYSICAL HAZARDS:** May explode on contact with water. Containers may rupture or explode if exposed to heat. Strong oxidizer. Contact with combustible material may cause fire.

**POTENTIAL HEALTH EFFECTS:**

**INHALATION:**





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**SHORT TERM EXPOSURE:** irritation (possibly severe), difficulty breathing, bluish skin color, lung congestion, death

**LONG TERM EXPOSURE:** lung damage

**SKIN CONTACT:**

**SHORT TERM EXPOSURE:** burns

**LONG TERM EXPOSURE:** rash

**EYE CONTACT:**

**SHORT TERM EXPOSURE:** burns, tearing

**LONG TERM EXPOSURE:** same as effects reported in short term exposure

**INGESTION:**

**SHORT TERM EXPOSURE:** burns, nausea, vomiting, diarrhea, stomach pain, convulsions

**LONG TERM EXPOSURE:** same as effects reported in short term exposure

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#### 4. FIRST AID MEASURES

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**INHALATION:** If adverse effects occur, remove to uncontaminated area. Give artificial respiration if not breathing. If breathing is difficult, oxygen should be administered by qualified personnel. Get immediate medical attention.

**SKIN CONTACT:** Wash skin with soap and water for at least 15 minutes while removing contaminated clothing and shoes. Get immediate medical attention. Thoroughly clean and dry contaminated clothing and shoes before reuse. Destroy contaminated shoes.

**EYE CONTACT:** Immediately flush eyes with plenty of water for at least 15 minutes. Then get immediate medical attention.

**INGESTION:** Never make an unconscious person vomit or drink fluids. Give milk. If vomiting occurs, keep head lower than hips to help prevent aspiration. If person is unconscious, turn head to side. Get medical attention immediately.

**ANTIDOTE:** calcium gluconate, intravenous; milk of magnesia.

**NOTE TO PHYSICIAN:** For inhalation, consider oxygen.

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#### 5. FIRE FIGHTING MEASURES

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**FIRE AND EXPLOSION HAZARDS:** Negligible fire hazard. Oxidizer. May ignite or explode on contact with combustible materials.

**EXTINGUISHING MEDIA:** regular dry chemical, soda ash, water

Large fires: Flood with water. Apply water from a protected location or from a safe distance.

**FIRE FIGHTING:** Move container from fire area if it can be done without risk. Cool containers with water



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spray until well after the fire is out. Stay away from the ends of tanks. For fires in cargo or storage area: Cool containers with water from unmanned hose holder or monitor nozzles until well after fire is out. If this is impossible then take the following precautions: Keep unnecessary people away, isolate hazard area and deny entry. Let the fire burn.

**FLASH POINT:** not flammable

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## 6. ACCIDENTAL RELEASE MEASURES

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### **OCCUPATIONAL RELEASE:**

Avoid contact with combustible materials. Do not touch spilled material. Stop leak if possible without personal risk. Reduce vapors with water spray. Do not get water inside container. Small spills: Flood with water. Large spills: Dike for later disposal. Keep unnecessary people away, isolate hazard area and deny entry. Ventilate closed spaces before entering.

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## 7. HANDLING AND STORAGE

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**STORAGE:** Store and handle in accordance with all current regulations and standards. Protect from physical damage. Keep separated from incompatible substances. Avoid heat, flames, sparks and other sources of ignition. Secure to prevent tipping. Keep separated from incompatible substances. NFPA 430 Code for the Storage of Liquid and Solid Oxidizing Materials.

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## 8. EXPOSURE CONTROLS, PERSONAL PROTECTION

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### **EXPOSURE LIMITS:**

#### **CHLORINE TRIFLUORIDE:**

0.1 ppm (0.4 mg/m<sup>3</sup>) OSHA ceiling

0.1 ppm ACGIH ceiling

0.1 ppm (0.4 mg/m<sup>3</sup>) NIOSH recommended ceiling

**VENTILATION:** Provide local exhaust or process enclosure ventilation system. Ensure compliance with applicable exposure limits.

**EYE PROTECTION:** Wear splash resistant safety goggles with a faceshield. Provide an emergency eye wash fountain and quick drench shower in the immediate work area.

**CLOTHING:** Wear appropriate chemical resistant clothing.

**GLOVES:** Wear appropriate chemical resistant gloves.

**RESPIRATOR:** The following respirators and maximum use concentrations are drawn from NIOSH and/or OSHA.

**2.5 ppm**



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Any supplied-air respirator operated in a continuous-flow mode.

**5 ppm**

Any self-contained breathing apparatus with a full facepiece.

Any supplied-air respirator with a full facepiece.

**20 ppm**

Any supplied-air respirator with a full facepiece that is operated in a pressure-demand or other positive-pressure mode.

**Escape -**

Any air-purifying respirator with a full facepiece and a canister providing protection against this substance.

Any appropriate escape-type, self-contained breathing apparatus.

**For Unknown Concentrations or Immediately Dangerous to Life or Health -**

Any supplied-air respirator with full facepiece and operated in a pressure-demand or other positive-pressure mode in combination with a separate escape supply.

Any self-contained breathing apparatus with a full facepiece.

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## 9. PHYSICAL AND CHEMICAL PROPERTIES

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**PHYSICAL STATE:** gas

**COLOR:** colorless

**ODOR:** sweet odor, pungent odor

**MOLECULAR FORMULA:** CL-F3

**BOILING POINT:** 54 F (12 C)

**FREEZING POINT:** -105 F (-76 C)

**VAPOR PRESSURE:** 1.46 atm @ 21.1 C

**VAPOR DENSITY (air=1):** 3.2

**SPECIFIC GRAVITY (water=1):** 3.2

**WATER SOLUBILITY:** reacts

**PH:** Not applicable

**VOLATILITY:** Not applicable

**ODOR THRESHOLD:** <3.0 ppm

**EVAPORATION RATE:** Not applicable

**COEFFICIENT OF WATER/OIL DISTRIBUTION:** Not applicable

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## 10. STABILITY AND REACTIVITY

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**REACTIVITY:** Reacts violently with water to generate toxic and/or flammable gases.

**CONDITIONS TO AVOID:** Avoid contact with combustible materials. Keep dry. Dangerous gases may accumulate in confined spaces. Keep out of water supplies and sewers.

**HAZARDOUS DECOMPOSITION:**

Thermal decomposition products: chlorine, acid halides

**POLYMERIZATION:** Will not polymerize.



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## 11. TOXICOLOGICAL INFORMATION

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### **CHLORINE TRIFLUORIDE:**

#### **IRRITATION DATA:**

21 ppm/12 hour(s)-intermittent eyes-rat; 21 ppm/12 hour(s)-intermittent eyes-dog

#### **TOXICITY DATA:**

299 ppm/1 hour(s) inhalation-rat LC50

#### **LOCAL EFFECTS:**

Corrosive: inhalation, skin, eye, ingestion

#### **ACUTE TOXICITY LEVEL:**

Toxic: inhalation

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## 12. ECOLOGICAL INFORMATION

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Not available

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## 13. DISPOSAL CONSIDERATIONS

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Dispose in accordance with all applicable regulations.

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## 14. TRANSPORT INFORMATION

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### **U.S. DOT 49 CFR 172.101:**

**PROPER SHIPPING NAME:** Chlorine trifluoride

**ID NUMBER:** UN1749

**HAZARD CLASS OR DIVISION:** 2.3

**LABELING REQUIREMENTS:** 2.3; 5.1; 8

#### **QUANTITY LIMITATIONS:**

**PASSENGER AIRCRAFT OR RAILCAR:** Forbidden

**CARGO AIRCRAFT ONLY:** Forbidden

**ADDITIONAL SHIPPING DESCRIPTION:** Toxic-Inhalation Hazard Zone B



### **CANADIAN TRANSPORTATION OF DANGEROUS GOODS:**

**SHIPPING NAME:** Chlorine trifluoride

**UN NUMBER:** UN1749

**CLASS:** 2.3; 5.1; 8

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## 15. REGULATORY INFORMATION

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**U.S. REGULATIONS:**

**CERCLA SECTIONS 102a/103 HAZARDOUS SUBSTANCES (40 CFR 302.4):** Not regulated.

**SARA TITLE III SECTION 302 EXTREMELY HAZARDOUS SUBSTANCES (40 CFR 355.30):** Not regulated.

**SARA TITLE III SECTION 304 EXTREMELY HAZARDOUS SUBSTANCES (40 CFR 355.40):** Not regulated.

**SARA TITLE III SARA SECTIONS 311/312 HAZARDOUS CATEGORIES (40 CFR 370.21):**

ACUTE: Yes

CHRONIC: No

FIRE: Yes

REACTIVE: Yes

SUDDEN RELEASE: Yes

**SARA TITLE III SECTION 313 (40 CFR 372.65):** Not regulated.

**OSHA PROCESS SAFETY (29CFR1910.119):**

**CHLORINE TRIFLUORIDE:** 1000 LBS TQ

**STATE REGULATIONS:**

**California Proposition 65:** Not regulated.

**CANADIAN REGULATIONS:**

**WHMIS CLASSIFICATION:** Not determined.

**NATIONAL INVENTORY STATUS:**

**U.S. INVENTORY (TSCA):** Listed on inventory.

**TSCA 12(b) EXPORT NOTIFICATION:** Not listed.

**CANADA INVENTORY (DSL/NDSL):** Not determined.

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**16. OTHER INFORMATION**

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